

CSR HOUSE

Understanding the science of building



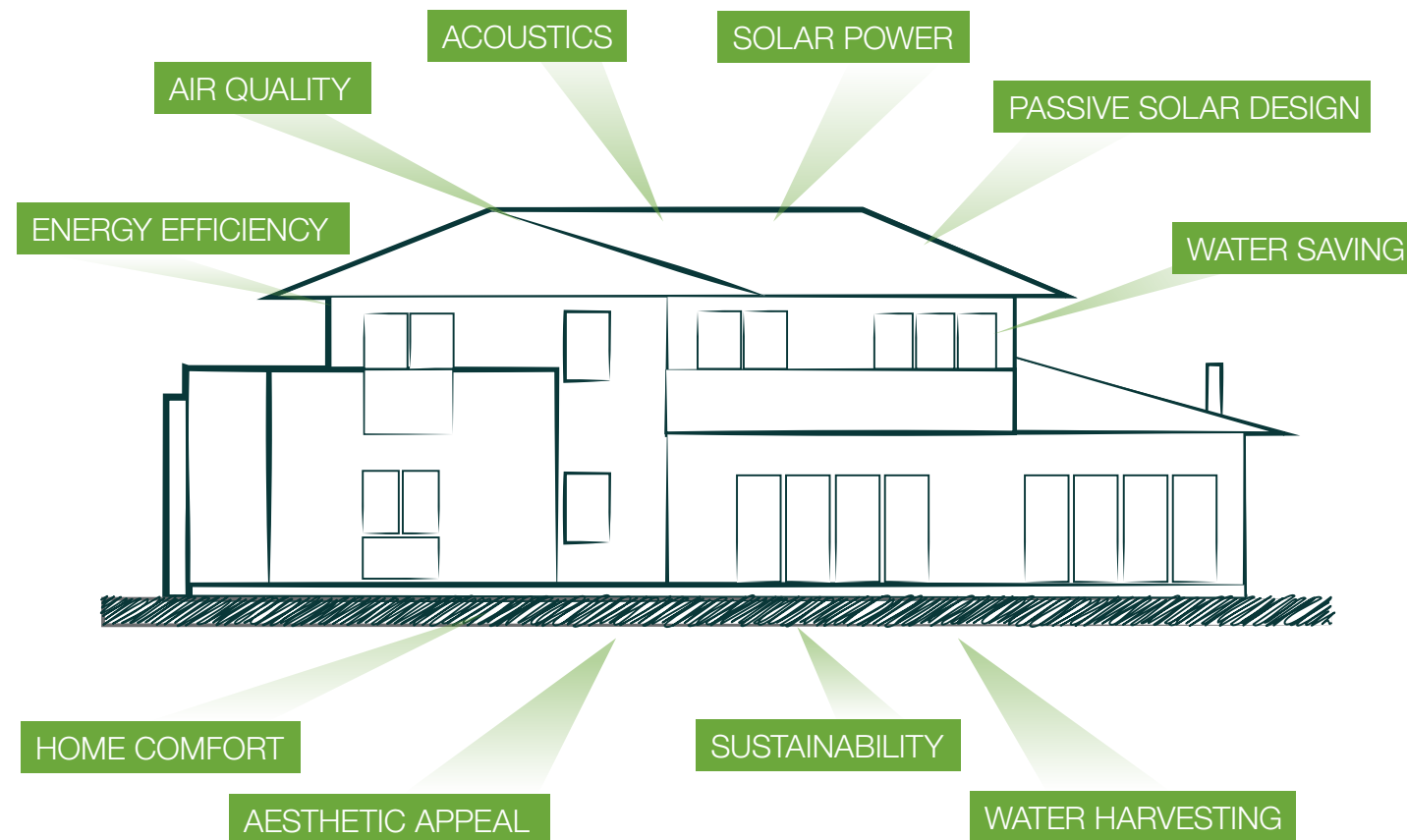
CSR

In search of an affordable, sustainable, energy efficient home

CSR is Australasia's leading building products supplier, driving innovation in the building and construction industry through continued investment in research and development to further improve building systems and solutions. This investment helps designers, builders and trades overcome the day-to-day challenges they face in design offices and on sites all around Australia and New Zealand.

CSR is at the forefront of developing practical building solutions for energy efficient housing. With the costs of energy rising and homeowners desiring ever more comfortable and attractive homes, the focus on energy efficiency and choice of environmentally responsible building products and aesthetically appealing homes has never been greater.

New homes built today are more environmentally friendly than in the past but there is still a lot of confusion about the best way to achieve the optimum in energy efficiency without significant costs. Aesthetics, comfort and lifestyle are major considerations for new home buyers and energy efficient homes need to meet all these market needs.



- 1 To identify inefficient building processes for further optimisation research
- 2 To conduct ongoing operational research on building performance
- 3 To showcase CSR's innovative product range

CSR House

As part of our commitment to the Australian building industry, we established the CSR House project to improve the knowledge surrounding the choice and use of building materials used in a typical family home.

The primary aim of the CSR House project was to design and build an attractive 8 Star energy efficient home as inexpensively as possible.

The project was designed to satisfy the three key objectives on the left but also for CSR to gain knowledge of how our products integrate with other building products and systems. We were looking for an in-depth understanding of the building process so we could better relate to our customers' needs.

We were determined to take a 'whole of building' approach and challenge established building practices to look for better ways to build.

We also wanted to establish an ongoing research facility of an actual house. This would allow us to undertake monitoring and experimentation of building performance options that could lead to the building of even more affordable, high performance homes.

Home Energy Rating

Thermal Comfort Star Ratings

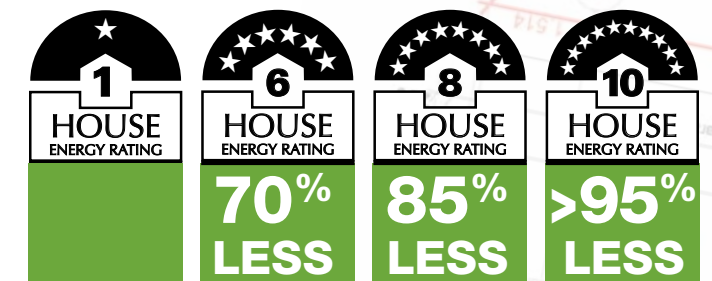
Heating and cooling energy makes up around 40% of the overall energy use in a home – the biggest home energy requirement by far.

In 2003, the Building Codes Board of Australia introduced tools to enable measurement and comparison of home designs. These 'Star' ratings are a prediction of a home's thermal comfort performance – an indicator of the heating and cooling energy required to achieve an acceptable level of comfort, based on local climate.

Many Houses built prior to 1990 were rated as 1 Star and today the average Star rating for existing Australian homes is about 2.8 stars.

The current energy efficiency provisions in the Australian Building Code call for new homes to be minimum 6 Stars*. A 6 Star home uses around 70% less heating and cooling energy than the average 1 Star home.

Additional stars represent huge jumps in energy efficiency. As an example, an 8 Star home requires 50% less heating and cooling energy than a 6 Star home and 85% less than the average 1 Star home.



Thermal Comfort

CSR House – 8 Star Quality Design

Achieving an 8 Star rating cost effectively meant careful consideration in design and choice of building materials. We wanted to challenge the usual perception that an energy efficient home requires expensive architect design or means compromising on looks and amenity.

The design by Ecologie Architects delivered on the brief to build a modest, contemporary home that was suited to the mainstream building market. The house was built at Schofields, in Sydney but we modelled over a million permutations of house orientation and different building materials in 23 different climate regions to show how robust the design performance would be, anywhere in Australia.

There are some imperatives for good energy efficient design:

- House orientation, window type and placement as well as eave shading to take advantage of Northern sun in winter and limit Northern and Western sun in summer
- Adequate levels of insulation in walls, ceilings and floors
- Draft proofing the building envelope
- Effective ventilation to control internal temperatures and air quality
- The use of high thermal mass building materials where appropriate and thermal coupling through the slab to the more stable ground temperature



6 Star model performance (current Building Code requirement)

By carefully considering the basics, we were able to achieve a 6 Star rating. The key points we needed were:

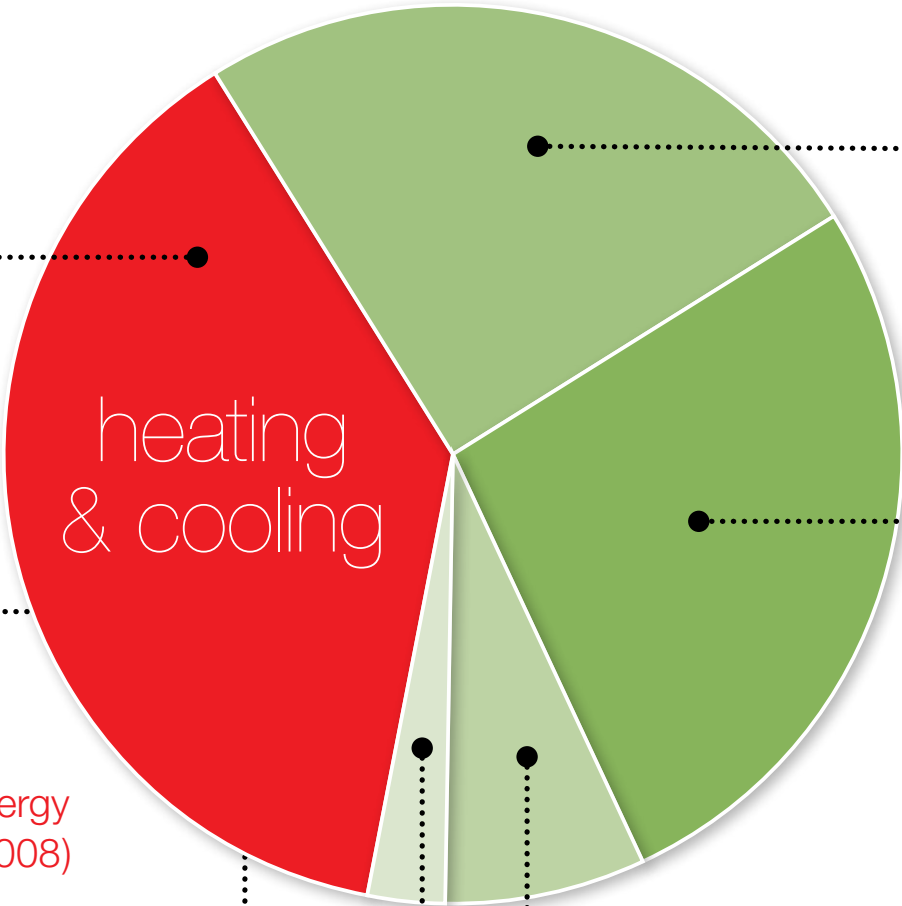
- ✓ Slab on ground construction
- ✓ Hebel Powerfloor for second storey
- ✓ Increased levels of Bradford external and ceiling insulation as well as Edmonds ventilation
- ✓ Upgraded window choice using standard frames with Viridian Smartglass
- ✓ Result 6.4 Stars



Achieving 8 stars

- ✓ Upgrade windows to argon gas filled, double glazing with low E coating and thermally isolated frames
- ✓ A reduction in total window area of 7m² (residual 58m² is still more than the average home)
- ✓ Increased insulation levels and added insulation to internal walls and mid-floor void
- ✓ Result 8.1 Stars

Note: CSR House Star Ratings verified by 2 independent energy assessors in both ACCURATE and BERS Pro software



Home energy use
(Baseline Energy Estimates, 2008)

Source: yourhome.gov.au

Whole of house energy

While heating and cooling energy use is the biggest home energy cost, there are other areas where significant savings can be made. In the CSR House, our approach was to start with the building fabric, then look at appliances, followed by solar energy.

Water Heating

The second largest single energy cost is the cost of heating water for cooking, cleaning and washing.

A solar water heater is a must and we chose a Hills Solar gas boosted, evacuated tube system because of its higher level of solar efficiency regardless of orientation. Gas boosting is a more energy efficient system than electric for those extra cold winter mornings.



Kitchen and other appliances

We chose Blanco and Omega appliances for their great looks and good appliance energy ratings. We believe that you do get what you pay for and a little more upfront for a top quality appliance can lead to continual savings over the life of the appliance.



Intelligent Lighting and Controls

We installed Philips LED and compact fluorescent lighting to maximise energy savings and help to create a flexible and more comfortable living environment. All lights are surface mounted to minimise ceiling air leakage.

A lighting automation system is installed to control the lighting and air conditioning for optimal energy management. The system can be accessed remotely via computer or smartphone.

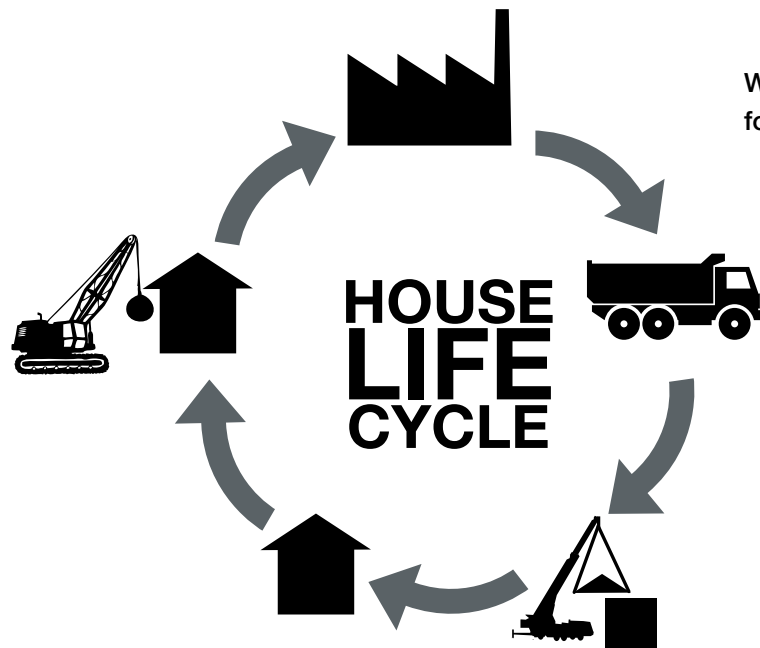


Standby Power

The little LED lights in your entertainment systems and appliances also contribute to a home's total energy use. Simply turning the power off at the wall switch can save on power bills.



Building a sustainable home



While reducing the reliance on energy usage from fossil fuels is a great start we wanted to make sure that the CSR House was a low carbon home.

We conducted a full lifecycle analysis of all products used for construction so that we could choose products to minimise the carbon footprint of the building.

The 8 Star CSR House achieved 712 Ecopoints* over a typical 50 year lifespan representing a 40% reduction compared to an equivalent sized 6 Star house.



GreenSmart
HOUSE

Using the HIA GreenSmart principles, the CSR House is registered as a GreenSmart House.

Sustainable from the ground up

Concrete slabs are generally formed using polystyrene void formers but we opted for an innovative, stackable polypropylene dome system which dramatically reduced transport volume compared with polystyrene. Made from recycled material, this system proved to be a better environmental choice with no waste to blow around the site.

Large quantities of energy are used to produce cement. We opted for Holcim EcoMax™ concrete which contains up to 65% less cement. The cement replacement materials result in a low embodied energy solution.

Hebel PowerFloor™ was used for the mid-floor instead of particle board. Hebel contains no volatile organic compounds (VOC) and provides high thermal and acoustic performance.



A renewable forest of frames

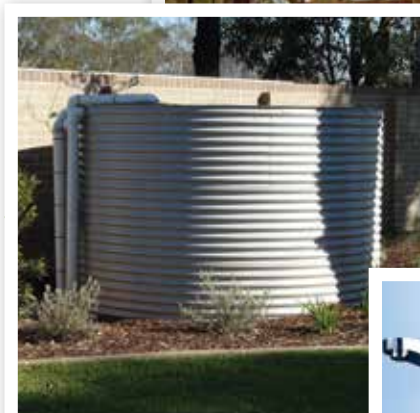
We opted for a timber frame for the CSR House. Timber is a renewable resource and has a lower impact on the environment than steel. It's also more thermally efficient than steel.

One important learning during construction was how the pre-fabricated frames were often designed in isolation from structural steel, bracing, distributed loads and lining products such as plasterboard. There is an opportunity to better integrate the design to reduce material costs and improve installation efficiencies.



Water efficiency and rainwater harvesting

Tapware and sanitaryware with 4 or 5 Star WELS rating were favoured to reduce water usage in the house. To minimise reliance on mains water supply, a 10,000 ltr rainwater tank with auto-switching is connected to all garden taps, toilets and the washing machine.



*BPIC Lifecycle Inventory Protocol

Healthy indoor environmental choices

As well as considering the sustainability values of the products used in the CSR House, occupant health and comfort was also a key objective.

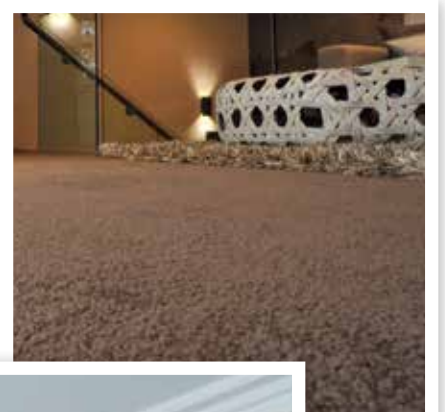
The design of the house maximises natural light for illumination and warmth and window and door placement was planned to allow for natural cross-ventilation.

Bradford Insulation and Viridian glass contributed to excellent noise control resulting in a remarkably 'comfortable' feel to CSR House.



Breathe easy with insulation and ventilation

Bradford™ Gold Batts and Bradford SoundScreen™ are used throughout the house and Edmonds Ventilation is installed in the roof to provide controlled natural ventilation. Both Bradford and Edmonds are endorsed partners of the National Asthma Council of Australia Sensitive Choice program.



Clean environment carpets

The carpet selected was Godfrey Hirst eco+. We were impressed by the manufacturing process which uses DuPont's Sorona® Polymer fibre which is derived from natural corn sugar with 63% less greenhouse gas emissions than conventional carpet.



Preferred paint production

The Dulux Ecosure paint range is manufactured with low levels of Volatile Organic Compounds (VOCs) We used these paints throughout the house.



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The CSR House includes a 1.5kW integrated PhotoVoltaic system using Monier SOLARtiles, which seamlessly integrate into the flat Horizon roof tiles used. This provides a stunning, streamlined roof profile.



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- Bradford SoundScreen™ R2.0 insulation to mid-floor and internal walls
- Bradford Gold HP R2.7 Glasswool insulation to external framed walls
- Bradford™ Gold R4.1 Glasswool insulation to ceilings
- Bradford EnviroSeal™ Roof Tile Plus sarking
- Bradford EnviroSeal™ Wall Plus – antiglare wall wrap to framed walls
- Bradford Granulated Cavity Insulation to cavity brick wall
- Bradford R2.0 Glasswool Duct Insulation to air conditioning ducts



- Edmonds™ Odyssey - intelligent hybrid home ventilation
- Edmonds™ Air-O-Matic
- Edmonds™ Eave Vents – intake for roof ventilation
- Edmonds™ Tile Vents - sewer stacks and bathroom vents



- Hebel PowerFloor™ for first-floor substrate
- Hebel PowerPanel™ to lower level external walls (rendered)



- Cemintel Designer Series™ to upper level external cladding and entry portico feature walls
- Cemintel Ceminseal™ Wallboard to all wet area walls
- Cemintel Soffitline™ to outdoor living area ceiling
- Cemintel™ Texture Coating System to entry portico rendered walls
- Cemintel™ Compressed Fibre Cement for first floor bathrooms and deck substrate
- Cemintel™ FC Eaves Lining Sheets to 900mm wide eaves



- Monier SOLARtile™ 1.5kW integrated PhotoVoltaic system
- Monier™ Horizon Roof Tiles
- Monier™ A-Line Ridge Capping for a slimline finish



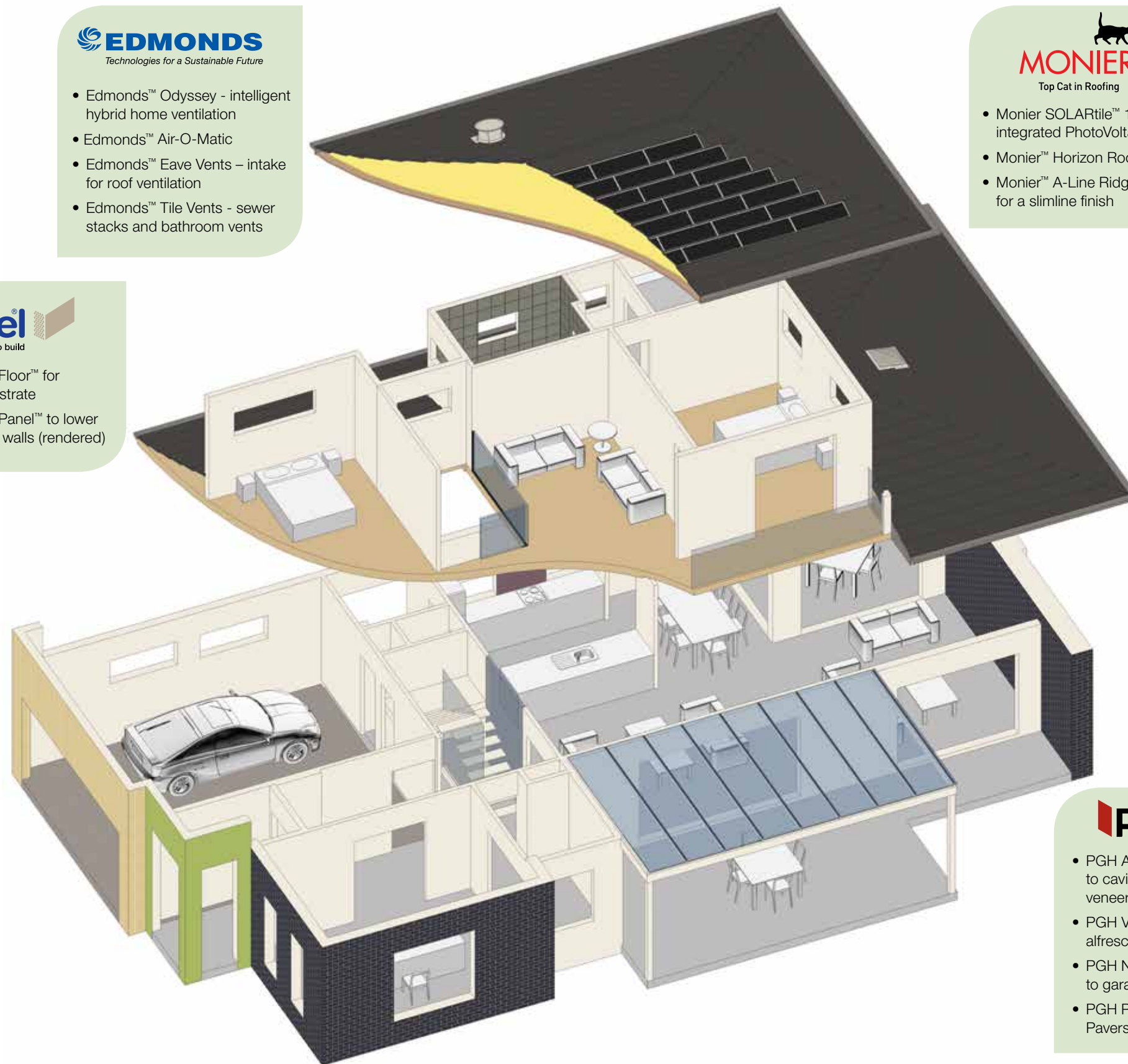
- Gyprock Superchek™ plasterboard to all walls
- Gyprock Supaceil™ plasterboard to all ceilings
- Gyprock™ decorative cornices throughout
- Gyprock™ Fire Mastic (Low VOC) to seal air gaps around windows and frames



- Viridian ThermoTech™ Low E IGUs (6mm SolTech™, Argon, 6mm EnergyTech™) to external windows and sliding doors
- Viridian VLam Hush™ SuperClear to internal doors and staircase panel
- Viridian VTough™ Clear for all glass balustrades, shower screens and kitchen splashbacks
- Viridian Copper-free DecorMirror™ for all bathroom mirrors
- Viridian VTough Renew™ to skylights and pergola



- PGH Alchemy Pewter bricks to cavity brick wall and brick veneer walls
- PGH Vibrant Wasabi bricks to alfresco feature
- PGH Northbridge Roman splits to garage parapet wall
- PGH Peppercorn and Chestnut Pavers for all paths



csr.com.au



To follow the design and construction of the 8 Star CSR House, visit our YouTube channel and register for updates www.youtube.com/user/csrhouseproject

CSR

Key Learnings

CSR House demonstrates how a contemporary 8 Star energy efficient home can be practical and affordable. The project helped identify optimisation opportunities, while providing a platform to conduct ongoing operational research and to showcase CSR's innovative product range. A focus on the building science proves similar principles apply for all building types. The findings include:

- Attention to detail improves energy efficiency, comfort, internal air quality and acoustics at low cost.
- An 8 star home has a theoretical heating and cooling load 45% lower than a 6 star home. Air control measures took this reduction to over 65%, significantly impacting operational costs.
- A simulated energy rating on twenty different locations around Australia found the energy rating was robust around the country.
- Reducing excessive frame elements improves the speed of electrical, plumbing & insulation installation and reduces thermal bridging.
- A thermally efficient home requires smaller air conditioning systems, reducing both up-front and operational costs.

Ongoing research

The CSR House will continue to be a valuable learning resource for CSR's future product and system development processes.

A full weather station is installed on the roof and the house is wired up with over 140 sensors and 3.5km of instrumentation cabling. Using these, we are monitoring:

- Heat flow through materials
- Thermal bridging across walls

CSR House Technical Guide

Visitors to the CSR House are amazed by its internal environment and the high levels of thermal comfort, acoustic serenity, natural daylight levels, controllable ventilation and general healthy home features. In response to this, we have developed the CSR House Technical Guide which documents exactly how these performance traits were achieved.

This guide details the design requirements, material performance specifications and installation guidelines to assist designers and builders to replicate the performance, comfort and liveability of a home as demonstrated by the CSR House.

The intent is to translate principles of building science into real world outcomes for Australian buildings and to demonstrate to builders how to ensure the star rating envisaged by the architect is maintained, while also weighing up the star rating against considerations like overall comfort of the home and affordability. The guide provides design and construction considerations based around the key aspects of building performance, including comfort, health of home and energy efficiency.

- Internal temperature and humidity conditions
- Subfloor conditions
- Ground temperature and moisture levels
- Energy usage of lighting, heating and cooling equipment

The CSR House is a living laboratory with the operational data and findings supporting many other research projects with leading Universities and the CSIRO.

Project Partners

CSR thanks our project partners for their support and advice throughout the CSR House Project.



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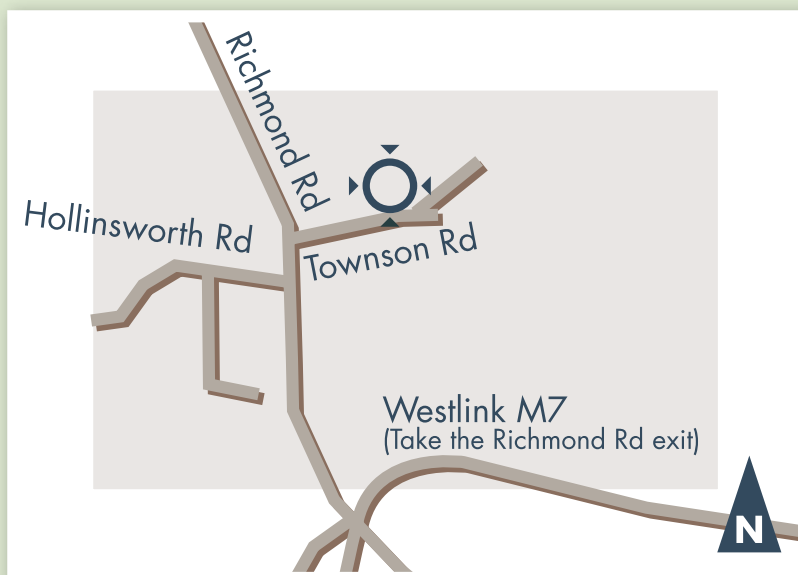
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*Come and see
for yourself!*

The CSR House is open to the public beside the Monier PGH selection centre at Townson Road Schofields, NSW. Turn off Richmond Road North of the M7 Motorway

Enquiries: 131 579



For more information on CSR's range of building products call 1800 633 826

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